Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

RAILWAY INVESTIGATION REPORT R17Q0061

Uncontrolled movement of railway equipment

Quebec North Shore and Labrador Railway
Train PH651
Mile 128.6, Wacouna Subdivision
Mai, Quebec
25 July 2017

Canada

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Railway investigation report R17Q0061

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Le présent rapport est également disponible en français.

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

On 25 July 2017, in order to carry out en-route switching operations, a Quebec North Shore and Labrador Railway consist of 159 cars loaded with iron ore had been left on the main track of the Wacouna Subdivision in Mai, Quebec. A few minutes after the locomotives were uncoupled from the consist, the cars began to roll uncontrolled and passed Signal 1286 in Mai. The relief locomotive engineer, who was located on the ground nearby, took action to stop the uncontrolled movement. There was no damage and no injuries.

Le présent rapport est également disponible en français.

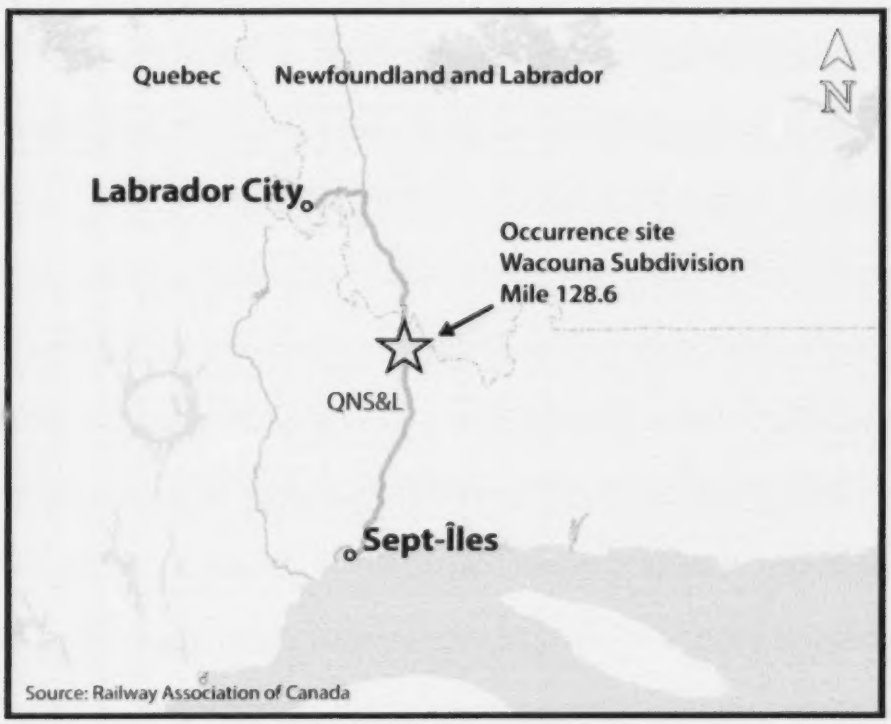
1.0 *Factual information*

1.1 *The incident*

On 25 July 2017, Quebec North Shore and Labrador Railway (QNS&L) train PH651 was travelling south on the Wacouna Subdivision. The train comprised 2 head-end locomotives and a cut of 159 cars loaded with iron ore. The train was approximately 5700 feet long and weighed about 20 000 tons.

At about 0025,[1] the train arrived in Mai, Quebec, Mile 128.6 (Figure 1), where a change of locomotive engineer (LE) was planned and locomotive QNSL 322, which was parked on the west siding, was to be added to the locomotive consist. In order to do so, the LE and the relief LE had to work together. The LEs agreed that the LE would uncouple the locomotive consist from the train while the relief LE would get locomotive QNSL 322 ready.

Figure 1. Map of the occurrence area (Source: Railway Association of Canada, Canadian Railway Atlas, with TSB annotations)



The LE stopped the train on the main track approximately 100 feet from Signal 1286, and then fully applied the automatic brake. Before the air had been completely exhausted from the brake pipe, the LE left the lead locomotive and closed the brake pipe angle cocks between the locomotives and the first car of the cut of cars. The LE then applied some hand brakes[2] on

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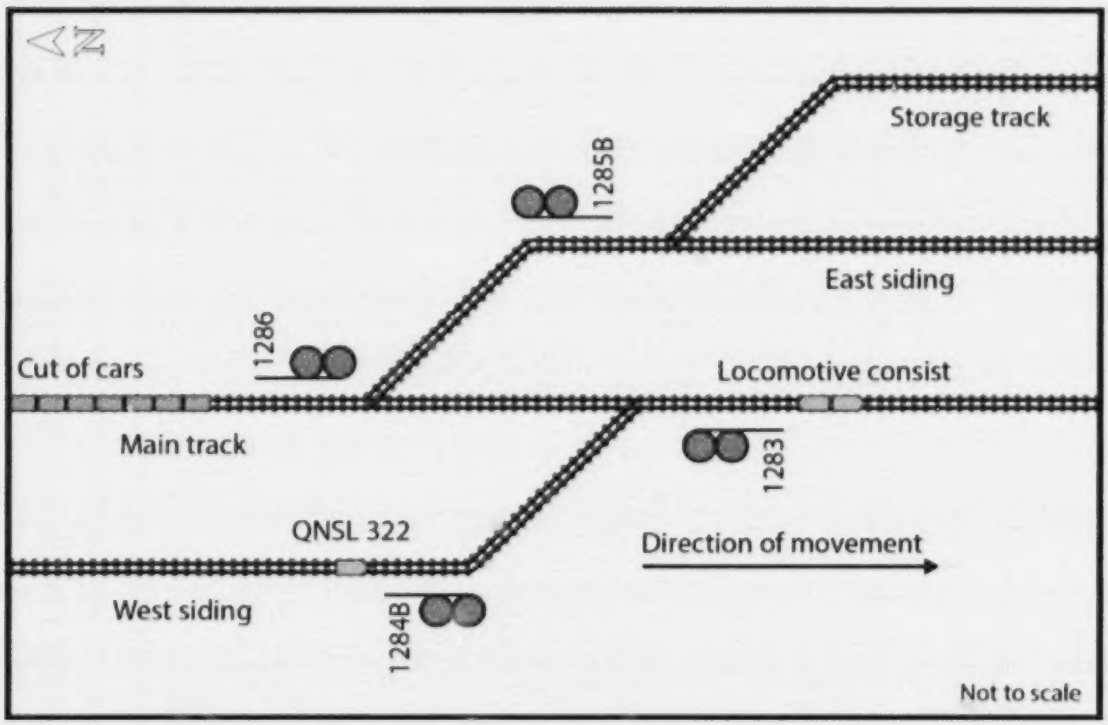
1 All times are Eastern Daylight Time.

2 The investigation could not determine exactly how many hand brakes had been applied.

the first cars and returned to the lead locomotive cab to uncouple the locomotive consist from the cut of cars by moving the locomotive consist some 10 feet southward. Subsequently, the LE left the lead locomotive again, walked toward the cut of cars and partially opened the brake pipe angle cock on the first car. The LE then went back to the lead locomotive, moved the locomotive consist, passed Signal 1286, which displayed a clear signal indication, and brought the locomotive consist to a stop south of Signal 1283 (Figure 2). Meanwhile, the LE did not indicate to the relief LE how the train had been secured.

Figure 2. Occurrence area



From his position south of Signal 1283, the LE could see the signal indication and reverse the locomotive consist toward locomotive QNSL 322, which was on the west siding.

While the LE was uncoupling the locomotives from the cut of cars, the relief LE moved locomotive QNSL 322 to the south end of the west siding. The relief LE then took up a position on the ground, west of locomotive QNSL 322, in order to guide the LE for the planned coupling operations. From that position, the relief LE noticed that the cut of iron ore cars had started to roll uncontrolled southward on the main track. The relief LE then headed toward the cut of cars, along the east side of the main track. From the ground, the relief LE fully opened the brake pipe angle cock on the first car of the cut of cars, which resulted in the application of the emergency brakes on the cars, thereby stopping the cut of cars. The first car travelled approximately 400 feet and came to a stop on the north switch of the east siding, approximately 150 feet beyond Signal 1286. However, the main track next to the west siding was not obstructed.

1.2 *Crew information*

At the time of the incident, QNS&L was the only federally regulated railway company in Canada that had single-person train operations. At QNS&L, single-person train operations were used only for iron ore trains.

The LE and the relief LE had started working at QNS&L in 2005 and 2012, respectively. Since their initial training,[3] they had requalified, every 3 years, on the *Canadian Rail Operating Rules* (CROR) as well as on the railway company's specific instructions.

On the morning of the incident, the LE had been on duty since 1900 the previous evening, and the relief LE was starting his shift after a rest period of some 20 hours. Both LEs met fitness and rest standards and were qualified for their respective positions. Both were familiar with the area, and it was not their first assignment in Mai.

1.3 *Site examination*

The Mai Station is located about midway between Sept-Îles, Quebec, and Labrador City, Newfoundland and Labrador. QNS&L has a base camp for engineering teams and for train crew changes in Mai. The station is approximately 4.5 miles long and comprises a single main track and 2 sidings, one on each side of the main track. Each siding has a spur track. Between the northern end and the southern end of the station, QNS&L has identified 16 areas where the track grade changes at irregular intervals as well as grades of up to 0.59%. Between Mile 129.7 and Mile 128.6 (Signal 1286), the main track has a downward grade of about 0.4% toward the south (Figure 3).

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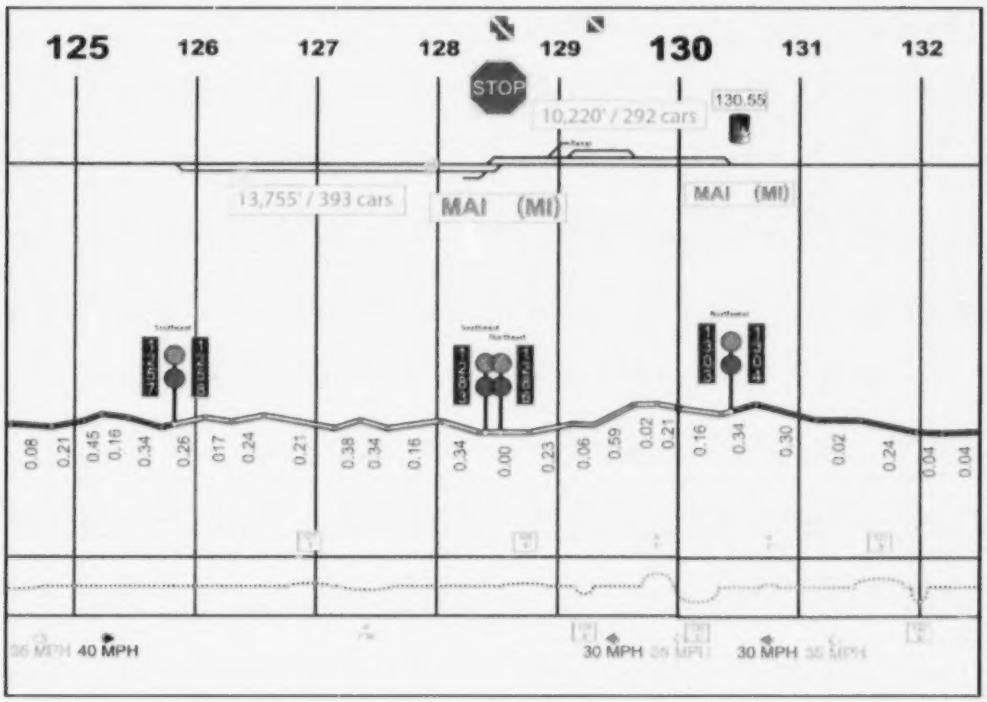
[3] Initial locomotive engineer (LE) training at Quebec North Shore and Labrador Railway, which lasts approximately 1 year, includes a classroom component followed by a practical component of about 1000 hours as an LE.

Figure 3. Layout of the track in Mai (Source: Quebec North Shore and Labrador Railway)



1.4 *Particulars of the track*

In Mai, the main track is composed of 136-pound continuous welded rail manufactured by Algoma in 1990, resting on 14-inch double-shouldered tie plates, with 4 spikes per tie. The rail is anchored every second tie, and the ballast is composed of ½-inch to 2-inch crushed stone.

Inspections had been carried out in compliance with the Transport Canada (TC)–approved *Rules Respecting Track Safety* (the Track Safety Rules, or the TSR). The last visual track inspection had been performed on 21 July 2017, and no defects were noted.

1.5 *Track information*

The Wacouna Subdivision is a single main track that connects Sept-Îles (Mile 8.9) to Emeril Junction, Newfoundland and Labrador (Mile 225.30). Train movements are controlled by the centralized traffic control system as authorized by the CROR and are supervised by a rail traffic controller (RTC) located in Sept-Îles.

The track is a Class 3 track, according to the TSR. Maximum speed on the subdivision is 40 mph for iron ore trains and freight trains, and 50 mph for passenger trains. Rail traffic consists of 9 trains per day (iron ore, freight, and passenger trains), for an annual tonnage of nearly 28 million gross tons.

Between Mile 55 and Mile 95 of the Wacouna Subdivision, the track has a continuously ascending grade toward the north. Over this distance, the grade on some sections exceeds 1.6%. Therefore, the locomotive consist of trains travelling from Sept-Îles to Labrador City must be powerful enough to climb grades of that magnitude.

1.6 *Rail operations at Quebec North Shore and Labrador Railway*

The Wacouna Subdivision connects the mining operations of the Iron Ore Company of Canada, located in Labrador City, to the port of Sept-Îles. Rail traffic on the Wacouna Subdivision consists mainly of iron ore trains, but QNS&L also operates freight trains from Sept-Îles, with 4 departures weekly.[4] Unlike iron ore trains, freight trains leave Sept-Îles mostly with loaded cars. Therefore, on the freight train route, the grade between Mile 55 and Mile 95 requires a greater effort from the locomotives.

According to QNS&L's operational plan, if additional locomotives are required for a freight train to be able to climb the grades between Mile 55 and Mile 95, the additional locomotives are left in Mai and a southbound train brings them back to Sept-Îles. This occurs 2 to 4 times per week, depending on the rail traffic.

1.7 *The train*

Before the train left Labrador City, a brake test and a pre-departure inspection had been carried out; all cars were in good condition. While en route, the train was inspected by several wayside detectors, and no anomalies were noted. When the train left Mai, a pull-by inspection was carried out, and no defects were noted. Upon arrival in Sept-Îles, the train was inspected once more, and no braking system defects were noted.

1.8 *Recorded information*

The TSB examined the data from the locomotive event recorder (LER) of the lead locomotive. Table 1 contains these data in detail.

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4 Departures from Sept-Îles on Mondays, Tuesdays, Thursdays, and Fridays.

Table 1. Data from the locomotive event recorder of the lead locomotive for 25 July 2017

Time	Speed (mph)	Brake pipe (psi)	Brake cylinder (psi)	End of train (psi)	Description of event
0028:23	0	80	83	79	The train stopped in Mai.
0028:59	0	78	84	79	The automatic brake was fully applied (suppression).
0030:01	0	60	84	73	The brake pipe pressure stabilized.
0030:13	0	60	84	82	The brake pipe pressure at the end of the train increased.
0031:15	0	81	61	82	The automatic brake was released.
0031:24	1	88	2	82	The locomotives moved about 10 feet.
0031:31	0	88	83	82	The locomotives stopped.
0033:04	0	88	78	82	The independent brake was released.
0033:11	1	88	3	82	The locomotives moved about 1300 feet.

The LER revealed that, once the train had stopped in Mai, there were 2 periods of inactivity in the LE's cab. The first period of inactivity lasted about 2 minutes and 15 seconds,[5] and the second lasted about 1 minute and 30 seconds.[6] In addition, when the cars were left on the main track, the air was bottled[7] in the brake pipe.

1.9 *Air brake system*

A rail car air brake system comprises 4 main components: the brake pipe, the control valve, the air reservoirs and the brake cylinder (Figure 4). The brake pipe interconnects the cars to each other up to the lead locomotive. It supplies compressed air to the reservoirs on the rolling stock and signals the control valve to apply or release the brakes.

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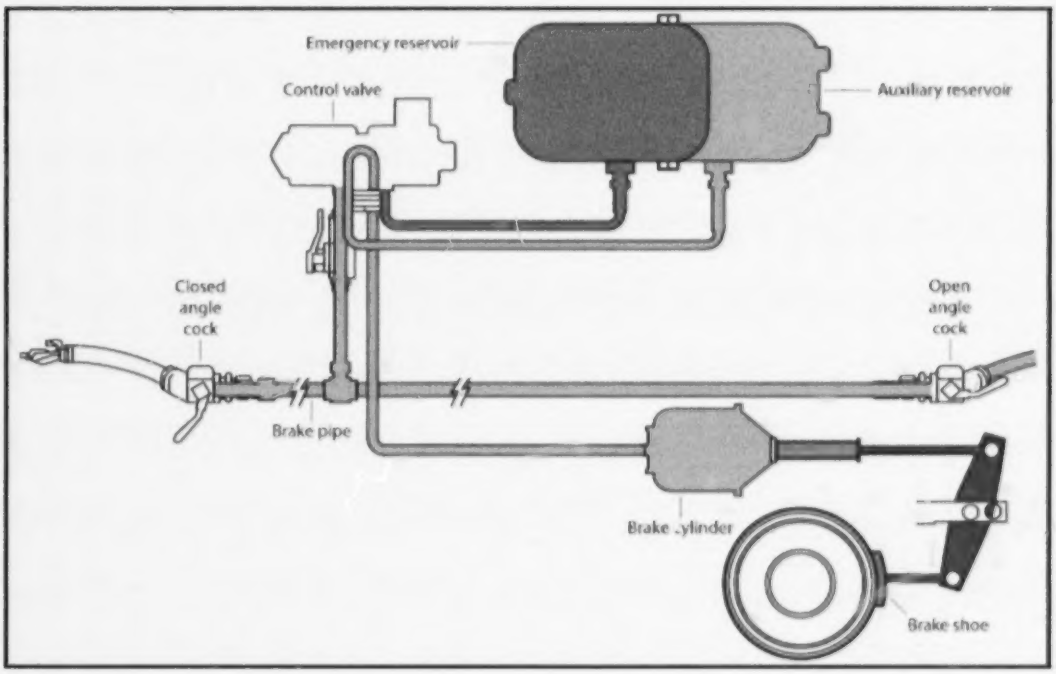
5 Between 0029:00 and 0031:15.

6 Between 0031:31 and 0033:04.

7 When the brake pipe is disconnected from the lead locomotive by closing the angle cock, the compressed air is trapped, which can lead to the unintended release of the air brakes.

Figure 4. Rail car air brake system



Each car has 2 air reservoirs: an auxiliary reservoir and an emergency reservoir. The auxiliary reservoir supplies air to the brake cylinder when the service brakes are applied. When the emergency brakes are applied, the brake cylinder receives compressed air from both the emergency reservoir and the auxiliary reservoir, which generates a greater braking force than service braking.

The control valve acts as intermediary between the brake pipe, the air reservoirs, and the brake cylinder. This valve reacts to air pressure changes within the brake pipe. When the pressure drops, the control valve supplies compressed air to the brake cylinder, which results in the brake shoes pushing against the wheels of the car. When brake pipe pressure increases, the brakes release.

The service brakes of rail cars can be applied gradually by the LE, depending on operational requirements. However, freight car brakes cannot release gradually. Therefore, as soon as brake pipe pressure increases (minimum of 2 psi), the brakes release completely.

1.9.1 Accelerated service release

The freight car air brake system in use in North America dates from the 1860s. As originally designed, when the LE released the brakes, the lead locomotive was the only source of air to resupply the brake pipe. The longer the train, the longer it took for the car brakes at the end of the train to release. This delay was one of the factors that limited train length. To overcome this problem, cars were equipped with control valves with accelerated release of the service brakes (accelerated service release, or ASR). When brake pipe pressure increases,

the ASR allows the car brakes to release and the emergency reservoir supplies compressed air to the brake pipe. Thus, each car equipped with ASR contributes to an increase in brake pipe pressure, which reduces the time required for the brakes to release on the cars at the end of the train.

1.9.2 Undesired release of the brakes

When a train's automatic brakes are applied, the air is withdrawn from the brake pipe starting at the lead locomotive[8] and the brakes are applied in sequence, from the first car to the last. While the brakes are being applied, a pressure gradient[9] is generated in the brake pipe; in other words, the pressure at the head of the train decreases before the pressure at the end of the train.

If the airflow within the brake pipe is interrupted and air is bottled in the brake pipe, the gradient will self-correct due to the equalization principle, which can cause the air brakes on the entire train to release.

To avoid the undesired release of the air brakes, it is necessary to ensure that airflow is not interrupted when the brakes are applied. In addition, once the cars have been uncoupled, the angle cock must be left fully open to avoid bottling air in the brake pipe.

1.10 Rules and specific instructions

In order to safely carry out the switching activities required for train operations, railway companies expect train crews to correctly interpret and apply the CROR and the company's General Operating Instructions (GOIs) while performing their work. In general, there are no physical defences to protect against the erroneous application of rules. All the safety measures are administrative in nature and depend solely, in each situation, on the correct application of the operating rules by the train crews.

1.10.1 Canadian Rail Operating Rules

CROR Rule 108, Precautions While Switching, states

> When switching is performed, precautions must be taken by crew members to prevent unintended rollbacks and/or fouling of other tracks and equipment.[10]

CROR Rule 112, Leaving Equipment Unattended, which was in effect at the time of the occurrence, states in part

> In the application of this rule:

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8 Only on a conventional train.

9 A difference in brake pipe pressure between the head of the train and the last car (only on a conventional train).

10 Transport Canada, TC O 0-167, *Canadian Rail Operating Rules*, Rule 108, Precautions While Switching (2016), p. 42.

(i) Equipment is considered unattended when an employee is not in close enough proximity to take effective action to stop the unintentional moving of equipment.

(ii) Physical securement or mechanical devices are:

- hand brakes;
- air brakes;
- derails;
- mechanical emergency devices;
- locomotive equipped with a reset safety control (RSC) with roll-away protection where air pressure is maintained by continuous operation or auto start is provided;
- bowled terrain; and
- if in a yard: retarder, stop-block, wheel chocks and skates.

[…]

(e) When hand brakes are used, an effectiveness test must be performed as follows: release all air brakes and,

(i) allow or cause the slack to adjust. It must be apparent when slack runs in or out, that the hand brakes are sufficient to prevent the equipment from moving; or

(ii) apply sufficient tractive effort to determine that the hand brakes provide sufficient force to prevent the equipment from moving when tractive effort is terminated [….][11]

In this occurrence, the LE estimated that the relief LE was close enough to the cut of cars and determined that CROR Rule 112 did not apply. Nonetheless, the LE applied some hand brakes on the first cars of the cut of cars before uncoupling the locomotive consist but did not check their effectiveness and was not required to do so.

According to the chart in CROR Rule 112 entitled "Minimum Required Number of Hand Brakes for Securing Equipment or Movements Left Unattended" (Appendix A), a minimum of 12 hand brakes would have been required to secure a 20 000-ton train left on a 0.4% grade.

1.10.2 Quebec North Shore and Labrador Railway General Operating Instructions

In addition to the CROR, railway companies have developed their own train operating instructions throughout their network.

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[11] Ibid., Rule 112, Leaving Equipment Unattended (2016) pp. 43–44.

Section 8, item 8.6.2, of QNS&L's GOIs in effect at the time of the incident states the following:

> **WHEN UNCOUPLING BRAKE PIPE**
>
> A full service reduction must first be made with the automatic brake valve and after the service exhaust has ceased, the angle cocks at the cut may be closed and air hoses disconnected.
>
> **Angle cocks must not be closed before the full service reduction has been completely made and the locomotive engineer has confirmed by radio or by engine whistle signal 14 (a) of the CROR that braking system is equalized.**
>
> The angle cock on the equipment to be left must be opened slowly and completely **to prevent an emergency brake application and left fully opened to the atmosphere.**
>
> **IT IS STRICTLY FORBIDDEN TO BOTTLE THE AIR IN THE BRAKE PIPE OF STANDING EQUIPMENT FOR WHATEVER THE PERIOD OF TIME.**
>
> **Exception:** unless a crew member is in position near the equipment angle cock in order to be able to put it in emergency brake application in the eventuality that it moves [....][12]

QNS&L's GOIs state that, when locomotives are uncoupled from the train, an emergency brake application must be avoided.[13] This reduces the time required to resupply compressed air to the brake pipe and avoids problems in cold weather.

Following the incident, the exception that allowed air to be bottled in the brake pipe was removed.

In spite of QNS&L's GOIs, the LE usually applied the emergency brakes rather than the service brakes to secure the equipment.

1.11 Training and supervision

Railway companies develop and operate their own training and qualification programs to meet their needs. In general, initial training and qualification programs include a review of relevant CROR rules and questions on this topic.

Among the conditions imposed to have single-person train operations at QNS&L, the company had committed to put in place a supervision program for its LEs that exceeded TC's requirements. As part of this program, every 2 months, a supervisor reviewed the LER from a work shift for each LE and, every 8 months, a supervisor accompanied each LE during a work shift.

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[12] Quebec North Shore and Labrador Railway, General Operating Instructions (2009), pp. 8-8 and 8-9.

[13] Applying the emergency brakes rather than the service brakes when rolling stock is secured has no negative impact on safety.

Throughout his career as an LE, the LE had not been involved in any accident. The latest verifications of the LE carried out by QNS&L had noted no non-compliance with existing rules.

In the weeks preceding the incident, a front-line supervisor had observed the LE performing his duties. The supervisor had noticed that the LE had left the emergency brakes applied on the cars during switching operations. The supervisor then informed the LE of the company's expectation in that respect, which was to avoid the application of the emergency brakes and to leave the cars with only the service brakes applied. During that discussion, no reference was made to the GOIs, the procedure outlined in the GOIs was not reviewed, and the consequences of not complying with this procedure were not mentioned.

1.12 Operations conducted in Mai

After uncoupling the locomotive consist from the cut of cars, the LE moved the locomotives forward, south of Signal 1283. While the LE was waiting for the signal indication to change in order to reverse toward the west siding, the signal displayed a restricting indication and, a few seconds later, a stop indication. The LE, having observed the successive changes of the signal indications, tuned his radio to the appropriate channel to communicate with the RTC and contacted the RTC to inform him of the situation. According to the RTC display panel, rolling stock had passed Signal 1286, which blocked all the signals in that location to a stop indication. In spite of the information displayed on the RTC panel, the LE confirmed to the RTC that the cut of cars was secured on the main track, north of Signal 1286. Therefore, the RTC issued an authority for the LE to pass Signal 1283 and reverse toward the west siding. After writing down the authority, the LE tuned his radio to the channel for train communications. At that moment, the relief LE informed the LE that the cut of cars had rolled uncontrolled and passed Signal 1286 before it was stopped.

After the LE was informed of the uncontrolled movement, both LEs talked about the occurrence before coupling the 2 locomotives to locomotive QNSL 322. After the locomotives were coupled together, they then had to go back to the main track to couple the locomotive consist to the cut of cars. While the LE was leaving the west siding, he passed Signal 1284B that was displaying a stop indication. When he reached the main track, south of Signal 1283, the LE contacted the RTC to ask for an authority to pass that signal and couple to the cut of cars.

1.13 En-route switching operations at Quebec North Shore and Labrador Railway

The TSB examined the LERs of 19 QNS&L trains that carried out en-route switching operations. Of these 19 trains, 8 were uncoupled with the emergency brakes applied (angle cocks open) whereas 11 were uncoupled while the brake pipe was exhausting at a service braking rate (angle cock open). Of the 19 LERs examined, 1 train had been operated by the occurrence LE. In that particular case, while he was uncoupling the locomotive consist, he had allowed an emergency brake application to occur.

2.0 Analysis

The train's air brake system was in good condition. Before the train left Labrador City, while en route, and upon arrival in Sept-Îles, it had been inspected and no braking system defects were noted. Both locomotive engineers (LEs) met fitness and rest standards, and were qualified for their respective positions. Therefore, the analysis will focus on the manner in which the cars were left on the main track in Mai, training, supervision and the switching operations carried out in Mai.

2.1 The incident

After the LE stopped the train in Mai, he fully applied the automatic brake. Immediately thereafter, he left the locomotive cab, closed the angle cocks between the locomotives and the first car of the cut of cars and applied some hand brakes. When the angle cocks were closed, the air had not completely exhausted from the brake pipe, which bottled the air in the brake pipe. With the angle cocks closed, an undesired release of the train air brakes began. After the locomotives were uncoupled, the LE went back to the first car to open the angle cock. However, the angle cock was only partially opened. Therefore, the flow of air in the brake pipe was not strong enough to apply the air brakes or for the drop in brake pipe pressure to be recorded, and there was not a sufficient number of hand brakes applied to secure the cut of cars. Air was bottled in the brake pipe, which caused the undesired release of the air brakes, and the cut of cars was able to roll uncontrolled and pass Signal 1286.

2.2 Training and supervision

When the LE carried out en-route switching operations, he usually left the emergency brakes applied on the uncoupled cars. This was common practice among several Quebec North Shore and Labrador Railway (QNS&L) LEs even though it was contrary to the procedure outlined in QNS&L's General Operating Instructions (GOIs). The last time that the LE had carried out switching operations, a supervisor had observed him and noted this non-compliance. Although the supervisor had informed the LE of the company's expectation in that regard, which was to avoid the application of the emergency brakes, he had not ensured that the LE mastered this procedure. The LE was not used to following the procedure that consisted of leaving the cars with only their service brakes applied.

When employees are being observed or undergoing regular performance assessments, if a deviation from an established operating procedure is noted, it is necessary to ensure that the appropriate corrective actions are taken, including employee training, if required. If railway companies do not ensure that their employees are completely familiar with the operating procedures that they must follow, some procedures might not be well understood or applied, which can increase the risk of accidents.

2.3 *Securing rolling stock*

In this occurrence, given that the relief LE was on the ground close to the cars, the LE determined that *Canadian Rail Operating Rules* (CROR) Rule 112 did not apply. Nonetheless, the LE applied some hand brakes on the first cars of the cut of cars.

CROR Rule 112 includes a chart that states the number of hand brakes to be applied to secure rolling stock according to its tonnage and the track grade. As such, a minimum of 12 hand brakes would have been required to secure a 20 000-ton cut of cars left on a grade of 0.4%.

When the air brakes on the cars released, the hand brakes applied did not keep the cars in place.

2.4 *Switching operations in Mai*

After the cut of cars left on the main track passed Signal 1286 while rolling uncontrolled, all the signals in that location were blocked in a stop indication. Therefore, the series of operations in Mai required the LE to write down several authorities from the rail traffic controller (RTC). The LE had written down an authority to pass Signal 1283 and reverse onto the siding. However, when he left that track, he had not requested an authority from the RTC to pass Signal 1284B. The LE was most likely concerned about the uncontrolled movement of the cut of cars and about the tasks required to carry out the switching operations. Therefore, while taking the locomotive consist out of the siding, the LE did not request an authority from the RTC to pass Signal 1284B, which displayed a stop indication.

3.0 Findings

3.1 Findings as to causes and contributing factors

1. Air was bottled in the brake pipe, which caused the undesired release of the air brakes, and the cut of cars was able to roll uncontrolled and pass Signal 1286.

2. The locomotive engineer was not used to following the procedure that consisted of leaving the cars with only their service brakes applied.

3. When the air brakes on the cars released, the hand brakes applied did not keep the cars in place.

3.2 Findings as to risk

1. If railway companies do not ensure that their employees are completely familiar with the operating procedures that they must follow, some procedures might not be well understood or applied, which can increase the risk of accidents.

3.3 Other findings

1. While taking the locomotive consist out of the siding, the locomotive engineer did not request an authority from the rail traffic controller to pass Signal 1284B, which displayed a stop indication.

4.0 Safety action

4.1 Safety action taken

4.1.1 Transport Canada

Following the occurrence, Transport Canada took the following actions:

- On 07 September 2017, a notice was issued to Quebec North Shore and Labrador Railway (QNS&L), which stated that:
  - Train crews do not have the tools or clear procedures to properly assess the average grade whey they have to secure equipment.
  - The exception in QNS&L's General Operating Instructions (GOIs) allowing air to be bottled in the brake pipe created some confusion among employees in order to determine if the rolling stock is attended or unattended.
- On 09 January 2018, an administrative monetary penalty was issued to QNS&L for contravening *Canadian Rail Operating Rules* (CROR) Rule 112 and section 17.2 of the *Railway Safety Act*, having left rolling stock unattended on the main track without applying the proper number of hand brakes and without performing an efficiency test.

4.1.2 Quebec North Shore and Labrador Railway

Following the occurrence, QNS&L took the following actions:

- Circular 17-546 was issued on 08 September 2017 amending Section 8, item 8.6.2, of QNS&L's GOIs by removing the exception that allowed air to be bottled in the brake pipe (Appendix B).
- Operating Bulletin 17-016 was issued on 15 September 2017 to stipulate that, in the application of CROR Rule 112, the maximum grade according to the track profile where the train is standing will be used to determine the number of hand brakes to be applied according to the chart in the rule (Appendix C).
- Training regarding the above changes was developed and delivered to all QNS&L locomotive engineers.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 29 August 2018. It was officially released on 10 September 2018.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

Appendices

Appendix A – Chart (k) of Rule 112 of the Canadian Rail Operating Rules

Minimum Required Number of Hand Brakes for Securing Equipment or Movements Left Unattended													
Total Tons:	Average Grade is Equal To or Less Than												
	0.2%	0.4%	0.6%	0.8%	1.0%	1.2%	1.4%	1.6%	1.8%	2.0%	2.2%	2.4%	> 2.4
0 - 2000	2	2	2	4	6	6	8	10	10	12	12	14	
> 2000 - 4000	2	2	4	6	8	12	14	16	18	20	22	26	
> 4000 - 6000	2	6	6	10	14	16	20	24	28	30	34	38	
> 6000 - 8000	4	6	8	12	18	22	26	32	36	42	46	52	
> 8000 - 10000	4	6	10	16	22	28	34	40	46	52	58	66	
> 10000 – 12000	4	8	12	20	26	34	40	48	56	64	72	80	
> 12000 – 14000	6	8	14	22	30	40	48	58	66	76	84	96	
> 14000 - 16000	6	10	16	26	36	46	56	66	76	88	98	110	
> 16000 - 18000	6	10	18	28	40	50	62	74	86	100	112	126	
> 18000 - 20000	8	12	20	32	44	58	70	84	98	112	128	146	
> 20000 - 22000	8	12	22	36	50	64	78	94	110	100% Hand Brakes			
> 22000 – 24000	8	12	24	38	54	70	86	104	122				
> 24000 - 26000	10	14	26	42	58	76	94	112	134				
> 26000 - 28000	10	14	28	46	64	82	104	124	148				
> 28000 - 30000	12	16	30	50	68	90	110	136	162				
> 30000	12	16	34	52	74	96	120	148	172				

Appendix B – Circular 17-546 issued by Quebec North Shore and Labrador Railway following the incident

CIRCULAR NO. 17-546

2017 09 08

GENERAL OPERATING INSTRUCTIONS SECTION 8, ITEM 8.6.2

The fourth paragraph of item 8.6.2, that begins with "Exception", on page 8-9 of section 8 of the GOI is cancelled.

It is strictly forbidden to bottle the air in the brake pipe of standing equipment for whatever the period of time. There are no exceptions to this instruction.

END OF CIRCULAR NO. 17-546, DATED 2017-09-08

Appendix C – Operating Bulletin 17-016 issued by Quebec North Shore and Labrador Railway following the incident

OPERATING BULLETIN NO. 17-016

2017 09 15

SPECIAL INSTRUCTION NO. 2 TO CROR RULE 112 K)

In the application of CROR rule 112 a) or b), Leaving unattended equipment, the track profile will be used to determine the maximum grade in the location that the equipment will occupy while it will be left unattended.

This document is available at the T&T [Transportation and Traffic] supervisor's office in Sept-Îles and at Carol Lake station. Each locomotive engineer must obtain a copy.

The maximum grade will be used in determining the number of hand brakes to apply at this location, according to the chart in CROR rule 112 k).

As an example, 164 loaded ore cars (20,500T) will be left unattended North of signal 1286 Wacouna subdivision. The length of the string of cars is 1.1 miles. According to the profile, the maximum grade between mile 128.6 and mile 129.7 is 0.59. With a grade of 0.6 and a tonnage between 20,000 and 22,000T, the chart indicates that a minimum of 22 hand brakes are to be applied.

After applying the hand brakes, an effectiveness test must be performed according to the requirements of CROR rule 112 e) and the Moisie division special instruction to this rule.

Note: If the profile is not available, the maximum grade can be obtained from the proper authority, by indicating to him the length and location where the equipment will be left unattended. It is the locomotive engineer's responsibility to determine the minimum number of hand brakes to apply according to CROR rule 112 k).

It is forbidden to bottle the air in the brake pipe of standing equipment for whatever period of time or location.

End of operating bulletin no. 17-016, dated 2017-09-15.